THE WESTERN CEDAR BORER

(*Trachykele blondeli* Mars.)

The Life-history, Distribution and Means of Control, with a Report on the Strength of Infested Poles

By

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DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
PAMPHLET NO. 94—NEW SERIES

THE ENTOMOLOGICAL BRANCH
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Published by direction of the Hon. W. R. Motherwell, Minister of Agriculture, Ottawa, July, 1928

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By Geo. R. Hopping, *Division of Forest Insects*

Introduction

The injury caused by the western cedar borer in parts of British Columbia has caused serious concern to the cedar pole interests due to the heavy losses sustained through discarding infested poles. The information obtained in a study of the problem indicates that much of this loss is unnecessary, and that, in general, poles are not materially weakened by the work of the borer.

A detailed investigation of the cedar borer problem was undertaken by the Entomological Branch in 1925, and has been continued by the writer during the past two years. The investigation is still in progress with regard to certain phases of the problem to be dealt with in future publications.

For valuable assistance rendered in this study, acknowledgment is made to the British Columbia Forest Branch, the Naugle Pole and Tie Company, the Baxter Pole Company, and to the cedar operators along the coast.

Sincere appreciation is tendered to Mr. T. A. McElhanney, Superintendent of the Dominion Forest Products Laboratories; to Mr. R. S. Perry, in charge of the Timber Testing Division of the Vancouver Laboratory, and to the men on his staff. It was through their co-operation that the strength tests embodied in this circular were made possible.

Acknowledgment is also due to H. H. Thomas, of the Entomological Branch, for his able assistance in connection with life-history studies in the field.

Description of the Borer

The western cedar borer, *Trachykele blondeli* Marseul, belongs to a family of beetles commonly known as flat-headed borers. The adult is a brilliant green beetle, from three-fourths of an inch to one inch long, and about one-fourth of an inch wide. Like other members of the same family, it is boat-shaped, but may always be recognized by several deep depressions on the prothorax.

The egg is whitish, oblong, one-tenth of an inch long, rounded at one end, bluntly pointed at the other, and covered with reticulations, forming cells usually hexagonal in outline.

The full-grown grub, or larva, is one and one-half inches long, white, and rather fleshy in appearance. At one end of the body there is a broadly oval, flat segment three-tenths of an inch in width which might be mistaken for the head, but which is actually the first segment or prothorax. On the dorsal or upper surface of this is a U-shaped, light brown mark which serves to distinguish this larva from other closely allied members of the same family. The true head is small. Behind the flattened segment, the body is much smaller, resembling a tail about one inch long, and composed of twelve segments, the first two of which are considerably swollen.

The larva changes to the resting stage known as the pupa, an intermediate form between the grub and the adult. This form is white like the larva, but the development of wings, legs, and other appendages is apparent.

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Life-history and Habits

The emergence of adults from infested trees commences about May 12 and continues until about June 10, varying with the season. The males and females emerge at about the same time and spend their entire existence in the crowns of the trees. They fly from tree to tree, but seldom descend below the crowns. The males fly about much more than do the females, probably seeking the latter. Mating takes place soon after emergence. Both males and females feed several times a day on the green cedar foliage. A female was observed to feed a great deal prior to oviposition; for seven days she remained upon the same branch, crawling here and there over the foliage to take full advantage of the sunlight or to feed.

Egg laying takes place from the middle of June to the middle of July. The female observed took approximately eight hours to lay between twelve and sixteen eggs, which were all placed on the southeast side of the tree, within a few feet of the trunk and on the upper sides of the branches. They were inserted deeply in small apertures formed by the overlapping scales of the bark, and were thus completely concealed. Often the eggs were deposited singly, but sometimes as many as six were placed together. The eggs hatch in from twelve to eighteen days.

It was evident that the eggs were sometimes deposited on the main stem up in the crown, since the beginnings of galleries have been found there. The evidence thus far obtained by us indicates that the eggs were not laid on the trunk below the crown, and never on any material other than living trees. *Poles will therefore not become infested after peeling. The borer will not spread from pole to pole in the yard or line.*

The minute, newly hatched larva excavates a tunnel from the limb into the main trunk. There it works either up or down the trunk and occasionally around it, following the annual rings. It generally works for a time in the sap wood, but later enters the heart wood and excavates the major portion of its gallery there. In feeding, the head moves slowly from side to side and, at each swing, a minute layer of wood is chewed away. This makes arcuate ridges on the gallery surface enabling one to determine, from an inspection of the gallery, in which direction the larva was tunnelling. Part of the boring dust is cast aside and gradually worked backward in the tunnel, while the remainder passes through the larva, the excrement being packed behind with the uningested dust. The exact length of time spent in the larval state is as yet unknown, except that it is at least two years. This was shown by breeding adults from a caged, standing tree for two successive seasons.

When the larva is full grown, it bores out to within half an inch or an inch of the surface, in whatever part of the tree it happens to be, and then excavates a cell in which to transform to the pupa. It often bores out into a limb for a few inches and pupates there. In other cases, pupation takes place near scars at the base of the tree, or in the main stem up in the crown.

Transformation to the pupal stage takes place in the late summer, from July 15 to August 15, and the pupal stage lasts for about twenty days, the adults remaining in the pupal cells during the winter, from September to May of the following year.

Galleries

A detailed study of the galleries indicates that the average length is not over twenty feet, and probably somewhat less. Intermingling of galleries causes extreme difficulty in tracing them, but several isolated ones have been traced to actively working larvæ, one of these in a freshly cut tree. In this case the larvæ were about one-third grown, and none of the galleries were over four feet

in length. The chart of the larvæ and adults which were found in the tested poles shows several cases where an adult has developed within a section four feet long, since there were no galleries showing on either end of the sections. Also there were few galleries at the centre of the sections.

Galleries excavated by nearly full-grown larvæ are about an inch wide, narrowly elliptical in cross-section, and closely packed with frass, with the exception of several inches directly behind the feeding larva. There seems to be no preference in the direction in which the galleries are excavated, except that the general direction is longitudinal in the trunk or limb.

Distribution

The general area over which the western cedar borer is common in British Columbia is found to be near tide-water. Badly infested areas extend in patches from Vancouver, on the mainland, as far north as the Yuculta rapids, and from Victoria to Courtenay on the eastern side of Vancouver island. In addition, heavily infested areas occur on many of the islands along the Inside passage, as far north as Seymour narrows. Heavy infestations are found up the Fraser watershed as far as Harrison lake. The borer has not been found in the interior of the province, and although a few indications of its work have been seen north of Seymour rapids, there are no severe infestations known there at present. It has been reported from the west coast of Vancouver island. The accompanying map indicates the general distribution, the areas of severe infestation, and approximately, the logged areas. Within the general region infested many smaller areas may be found entirely free from borer work. The pole operator who can select these may avoid serious loss, or even failure of the venture, so long as infested poles are excluded from the market.

Site Factors in the Distribution

The most favourable exposures for the borer are from southeast to southwest. The adult is a sun-loving insect, and naturally selects trees which have their crowns in sunlight for the major part of the day. Severe infestations seldom occur in swampy sites, where the trees are heavily shaded.

There is a fairly definite altitude limit above which the work of the borer becomes very scarce or entirely disappears. This elevation has been determined as between 800 and 900 feet above sea level. In investigating this point, thirty of the cedar operations along the coast were visited, and in every case where the operators were working above 800 feet, no serious trouble with the borer was encountered. At lower levels, some of these operators worked in spots of heavy infestation. Climatic conditions are probably responsible for this altitude limit.

Control Measures

From the operator's standpoint, there is no certain way to determine, from the external appearance of a standing tree, whether it contains borer work or not, except in some cases where exit holes can be found near the base of the trunk. Chopping into a tree will sometimes reveal the galleries, but this is not reliable, since trees very often have only the upper parts affected. Because of this difficulty of recognizing infested trees by inspection, there is no practical method of applied control under present forest conditions.

Logging methods are, to a limited extent, responsible for the extension of infested areas to include untouched trees in the surrounding stands. On an unlogged area, the adults often lay their eggs on trees already infested. When such trees are removed, the adults emerging from the logging debris have to seek

farther afield for living trees. If the slash, especially the tops left after logging, on cedar operations, were burned as soon as possible after logging, it would help to prevent the spread of the borer to new areas.

Submergence Experiment

A preliminary test to determine the effect of a pole submergence in fresh water on the mortality of the larvæ was conducted at Pender Harbour in June and July, 1926. The results show that larvæ are much more difficult to kill by this method than was generally supposed.

A pole, 25 feet long, with an 8-inch top diameter and 14-inch base, was submerged in fresh water on June 11. It was taken from the water on July 11. and the examination completed on July 19. The pole was cut into fifteen equal sections, numbered consecutively from the small end. Each section was then split into fine pieces in order to obtain all of the larvæ contained therein. The accompanying table shows the number of living and dead larvæ in each section. The first section yielded a living adult in addition to the larva listed. A check pole was unnecessary, as the condition of the dead larvæ clearly indicated that they had been killed by the effects of the water.

Section	Larvae alive	Larvae dead	Section	Larvae alive	Larvae dead
			9		
1		1	10	1	
2	2	2	11	1	
3			12	2	
4	2		13		
5			14		
6			15	1	
7		1			
8			Totals	9	4

The water did not penetrate more than one-fourth to one-half of an inch into the wood and the heart wood remained quite dry. Obviously, the results of this experiment indicate that submergence of poles for moderate periods is useless for the purpose of killing the larvæ of the western cedar borer.

Strength Tests

method of testing*

The information contained in the accompanying table is the result of tests made by the Forest Products Laboratories of Canada on three groups of western red cedar telephone poles, secured by the Entomological Branch for the study of the effect of western cedar borer attack on the strength of poles.

Under examination in the tests, pole A-10 was found to be infested and pole B-4 was found to be sound, in the latter case slight work of a sap borer in one end having been mistaken for western cedar borer when the poles were marked. These poles had to be interchanged between Groups A and B. It was necessary to exclude pole C-3 from the tests because of mechanical defects—excessive crook, sweep, etc.

All tests included in this study were made under exactly similar conditions and are, therefore, directly comparable. The first shipment, comprising ten uninfested poles (Group A) and eleven infested poles (Group B) were received at the laboratory on January 15, 1926, and the second shipment of fourteen infested poles (Group C) on April 23, 1926. The poles were weighed and

* This explanation is supplied by Mr. R. S. Perry, Timber Tests Engineer, Vancouver Forest Products Laboratory, Forest Branch, Department of Interior.

measured immediately on delivery and then stacked under cover to season. Testing was commenced on November 15, 1926, and continued during the season of high humidity. Each pole was assigned identification marks indicating the shipment, group, and test number.

All poles were 25 feet long with a nominal top diameter of 7 inches. Each pole was tested according to the standard practice of the laboratory over a span of 23 feet, on the 100-ton Olsen Universal testing machine. The poles are supported one foot from each end on hardwood blocks attached to steel plates, which in turn rest on half-rocker type bearing blocks, and the load is applied four feet from the butt support (five feet from the butt of the pole) through a similar hardwood loading block, at a uniform rate of descent of head of 0·6 inches per minute until failure. This loading is used to simulate service conditions where the pole is placed in the ground to a depth of five feet, and the top support represents the cross arm or line pull on the pole.

Before testing, the poles were placed upright in a tank of water for from one to three weeks, the butt 5 feet being submerged, and the top section protected from the weather by canvas coverings. This method was employed to simulate service conditions where the part of the pole in the ground would be continually moist. It was found that the sapwood quickly absorbs a large quantity of moisture, but that the heartwood shows little or no change in moisture for any period of soaking which was practicable.

Poles were taken from the tank as required for testing, weighed, and measurements made of length and of circumference at each end, points of support, load point, and centre line. The top reaction due to the weight of the pole itself was found by resting the top at the point of support on a scale with the butt resting on a suitable bearing. The age, average number of rings per inch, and the percentage of summer wood and sapwood were recorded, and the size and position of all defects noted. Poles were tested to complete failure, each type and place of failure being noted in order of occurrence. Following the test a moisture disc was cut from a point two feet from the top of the pole and cut into five sections to show the distribution of moisture.

From the observed maximum load and the measurements of each pole, the top reaction at the maximum load and the modulus of rupture were calculated. The latter figure is of most value for making comparisons between individual poles, for it is the computed maximum stress per square inch at the load point.

TEST RESULTS

Group C poles were not seasoned to as low a moisture content as Group A or Group B poles. Had they been so, the average modulus of rupture figure would undoubtedly have been from 300 to 400 pounds higher, closely approaching the average figure for Group B.

Poles A-10 and C-2 with 4,406 pounds and 4,479 pounds respectively, for modulus of rupture values, were the only poles showing material weakness which could be definitely ascribed to the work of the western cedar borer. Decay was partly responsible for the early failure of A-10, since there was considerable heart rot at the point of fracture. The average modulus of rupture figure for the infested poles fell slightly below the figure for the group of sound poles.

It is significant that the average modulus of rupture figure for each of the infested groups exceeds by several hundred pounds the figure of 5,600 pounds per square inch, which is now under consideration by the American Engineering Standards Association as a new high standard for western red cedar poles. This figure has also been tentatively suggested for inclusion in the National Electrical Safety Code.

Mortality of Larvæ in Seasoned Poles

The poles used in the strength tests were grown under practically the same conditions, on timber berths 378 and 290, on the west shore of Pitt lake, B.C. They were cut subsequent to March, 1925, so that the time elapsing between cutting and testing was less than two years. This becomes important in connection with the mortality of the larvæ found in the poles.

After coming from the testing machine, each infested pole was cut into two-foot sections, and a thin wafer cut off between all sections showing galleries. In this way, a record of the number of galleries appearing in cross-sections at two-foot intervals was secured for every infested pole. Each two-foot section was split into fine material, in order to secure practically all of the larvæ, adults, and pupæ contained in each pole.

Each horizontal division of plate X represents a pole, and the vertical divisions represent the sections into which each pole was sawn. The sections are numbered consecutively from the small end of the pole, and each larva, adult, and pupa appears in the section in which it was found in the actual pole. The solid black figures indicate dead individuals, and the white figures, the living ones. The pole designations in the extreme left-hand column correspond to the designations in the strength table. The small figures between sections, and at the ends, represent the number of galleries appearing on the cross-sections at those points.

The poles contained 8 living adults, 8 dead adults, and 1 dead pupa. *Of the total of 122 larvæ, 90 were dead. No cause of death was apparent other than the seasoning of the poles, producing conditions presumably too dry for larval existence. This is an indication that many larvæ are killed by the process of seasoning the pole.*

Only eight of the twenty-four poles contained living larvæ, and two of these contained but one each. The average number of living larvæ per pole was 1·33, and the largest number in one pole was 7. In this connection, attention is called to the freshly cut pole used in the submergence test. This pole contained no shrivelled larvæ similar to those in the seasoned poles. Another freshly cut pole, which was examined in August, 1927, contained 19 living larvæ and one shrivelled one. In the near future, it is planned to conduct seasoning experiments with freshly cut poles, and seasoning over definite periods of time, in order to investigate this phase of the problem more fully.

Some pole buyers have observed adult beetles emerging from poles in the yard and have concluded that the larvæ continue to destroy the pole after it is cut. Infested poles often contain over-wintering adults and nearly full-grown larvæ when they arrive in the yard. These undoubtedly complete their life cycle and emerge, and have probably given rise to the conclusion just mentioned.

Many poles which have failed in service before the normal replacement period have been found to be riddled by boring insects. In most cases of this kind, it has been found that the damage was caused by white ants or termites, which generally enter the pole after it is up in the line.[1] In some cases such failures have been wrongly attributed to the work of the western cedar borer. *The examination of the infested poles in the test, however, indicates that the damage by the cedar borer larvæ, caused to poles subsequent to cutting, is relatively small.*

Summary

1. The life-history of the western cedar borer has been determined as follows: Adults emerge from May 10 to June 10. Egg laying takes place between June 15 and July 15, with an incubation period of from 12 to 18 days. The

[1] In the Timberman for Nov., 1926, there is an article by Mr. T. E. Snyder on the damage to telegraph poles by white ants.

larval period is at least two years. The pupal stage lasts about 20 days, from late July to early August. The adults remain in the pupal cells from September to May of the following year.

2. A study of the life-history has shown that poles will not become infested after cutting and peeling.

3. Evidence shows that the average length of the western cedar borer gallery is less than 20 feet.

4. The areas in British Columbia which are badly infested by the cedar borer extend in patches along the mainland coast, the islands of the Inside passage, and the east coast of Vancouver island, from the International Boundary to Seymour narrows. Heavy infestations occur up the Fraser watershed as far as Harrison lake.

5. It has been found that the most favourable sites for the borers are from southeast to southwest exposures, and that there is an altitude limit of approximately 800 feet, above which the borer becomes scarce and the damage negligible.

6. There is no complete method of applied control under present forest conditions, but if cedar slash were burned as soon as possible after logging, it would help to prevent the spread of the borer to new areas.

7. The results of submerging a pole in fresh water have not proved successful enough to recommend it as a practical method of killing the larvæ of the cedar borer.

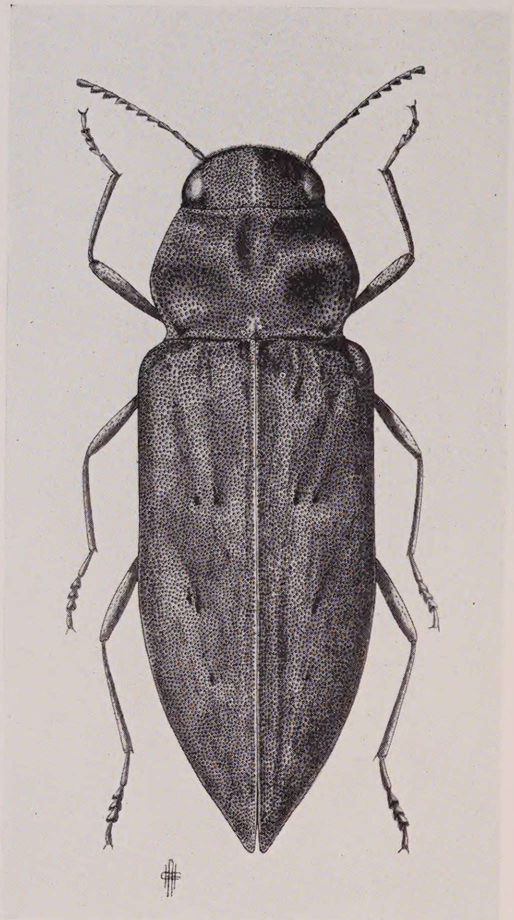
8. It has been conclusively shown that there is no material reduction in the strength of a large majority of poles infested by the cedar borer.

9. Evidence collected in the examination of seasoned poles subsequent to testing, indicates that the majority of larvæ die when the pole becomes thoroughly seasoned, and that the damage caused to poles after cutting is relatively small.

From the strength tests in conjunction with subsequent pole examinations, it is evident that poles which do not show more than four galleries on a single end, or a combined number of more than six galleries on the two ends, are not materially weaker than sound poles, and, other things being equal, would give as good service in a line.

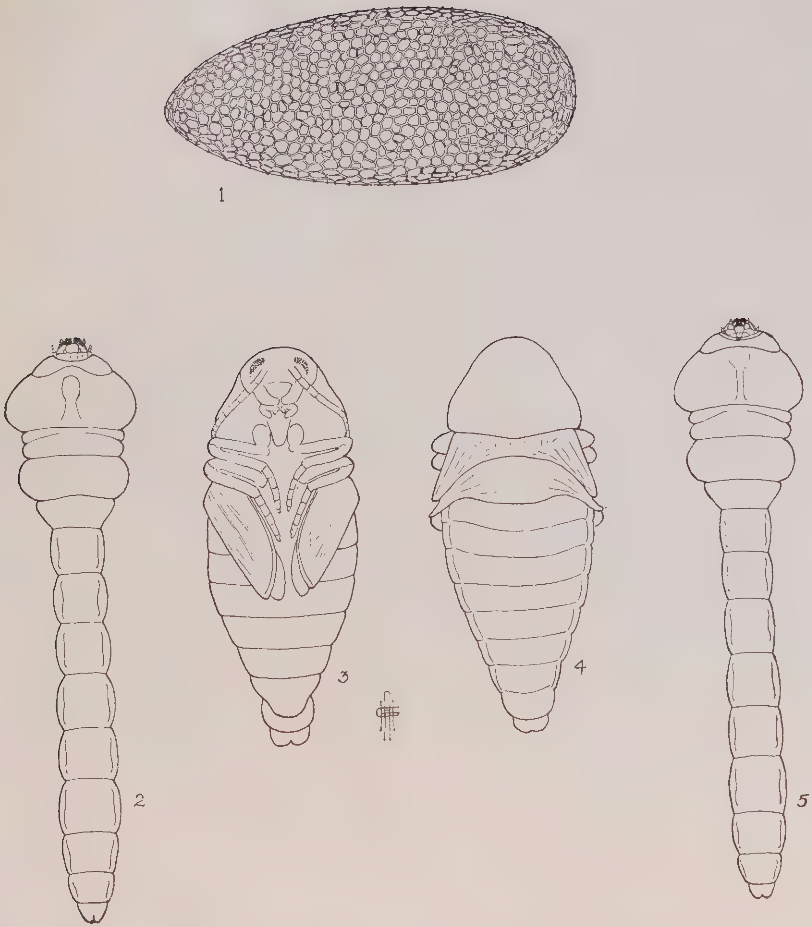
It is hoped that these experiments may help to eliminate some of the present tremendous waste of telegraph poles and effect an appreciable saving to the pole industry by eliminating the loss in handling charges on poles which are later rejected.

PLATE I



Adult of the western cedar borer. (Author's Illustration.)

PLATE II



Egg, larva and pupa of the western cedar borer. (Author's illustrations.)

PLATE III.

FIG. 1.—A cage enclosing the crown of a western red cedar. This was used for studying the emergence of adults.

FIG. 2.—Looking for adults of the western cedar borer. This is the tree upon which the egg laying was witnessed.

PLATE IV.

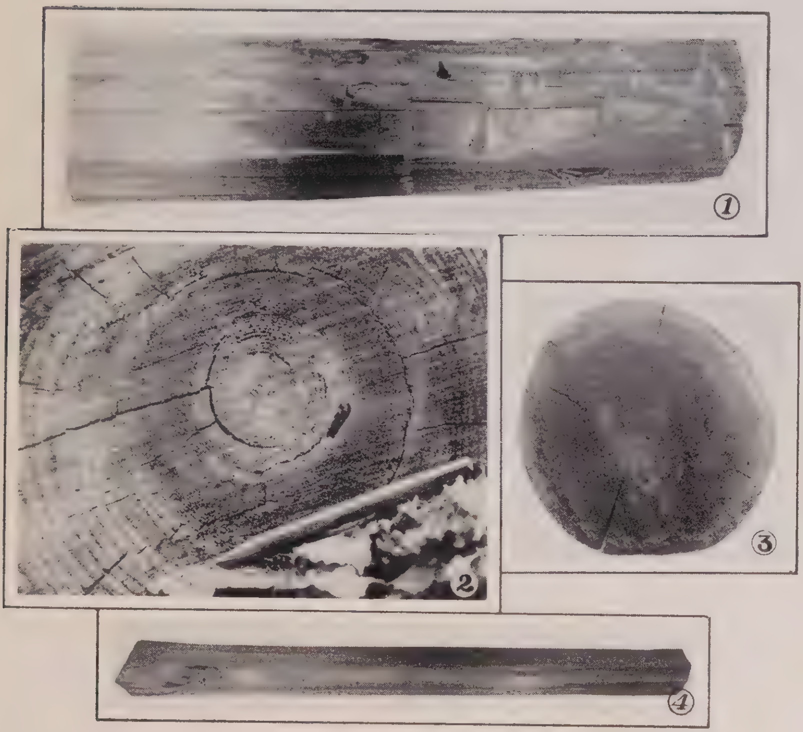


FIG. 1.—A two-foot section of pole B3 showing a working larva and an adult in the over-wintering chamber (the dark spot).

Photo by A. A. Dennys

FIG. 2.—Cross section of cedar showing four galleries of the western cedar borer.

Photo by N. L. Cutler

FIG. 3.—Cross section of pole C2 taken two feet from the butt end.

Photo by A. A. Dennys

FIG. 4.—A gallery showing the rapid increase in the width of the tunnel due to the growth of the larva.

Photo by A. A. Dennys

Plate V

Female of the western cedar borer laying its eggs on a limb of western red cedar.
(Author's illustration)

PLATE VI.

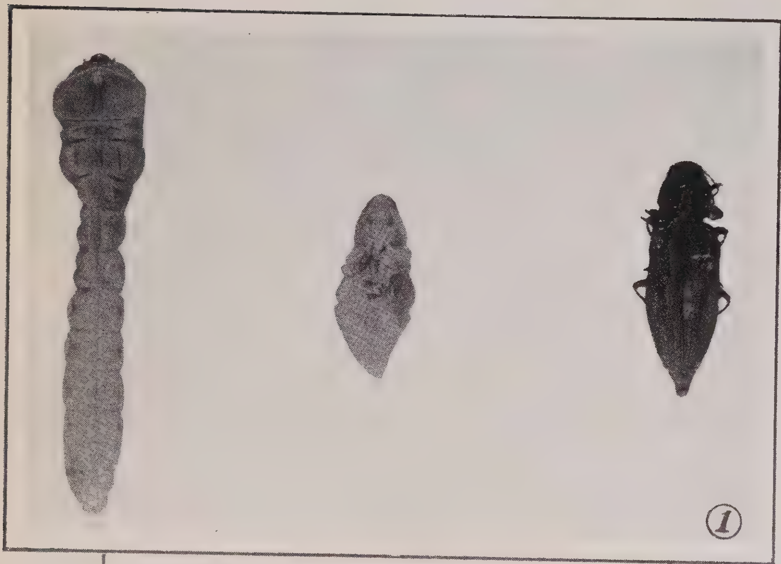
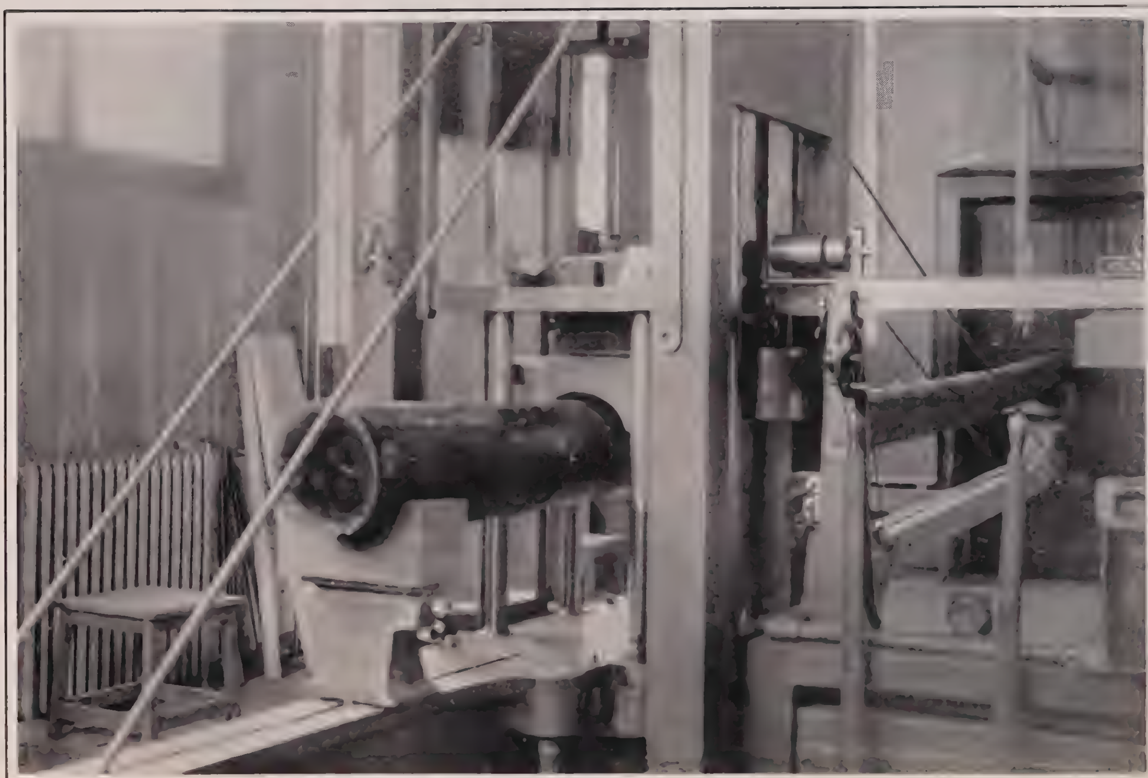


FIG. 1.—Larva, pupa, and adult of the western cedar borer.
Photo by A. A. Dennys

FIG. 2.—Debris left after logging in cedar.
Photo by N. L. Cutler

PLATE VII.



A pole in the testing machine at the beginning of the test.
Photo. courtesy of the Dom. For. Prod. Lab.

Plate VIII.

A pole in the testing machine after failure.

Photo. courtesy of the Dom. For. Prod. Lab.

Plate IX—Summary of results of tests on individual telephone poles of western red cedar with average results obtained therefrom for each group. Tests made in conjunction with entomological studies by Mr. G. R. Hopping at the Forest Products Laboratories of Canada Vancouver, B.C.

A GROUP.—SOUND POLES WITH NO INDICATION OF WESTERN CEDAR BORER

Pole No.	Rings per inch	Summerwood	Sapwood	Age	Moisture: Top section	Diameter: At load	Weight	Weight per cu. ft.	Maximum load	Top reaction adjusted to 7 inch top diam.	Modulus of rupture. Lbs. per square inch	Remarks
		p.c.	p.c.	years	p.c.	inches	lbs.	lbs.	lbs.	lbs.		
A-1	....	....	......	......	17·7	11·1	432	29·3	25,830	2,412	7,697	
2	25	26	18·2	175	20·9	10·3	342	27·3	19,230	2,478	7,167	
3	19	24	20·7	137	22·2	10·3	327	26·7	16,050	2,359	6,013	Numerous large knots.
4	38	27	17·5	158	20·9	9·7	325	26·5	17,470	2,451	7,823	
5	20	....	11·1	125	21·6	10·2	357	26·4	19·290	1,701	7,445	
6	26	35	11·5	156	23·3	10·8	364	26·5	21,950	2,293	7,079	
7	16	29	19·2	115	18·8	11·0	375	28·8	17·350	2,571	5,318	Numerous large knots.
8	24	29	15·5	125	25·3	10·0	368	32·3	18,860	2,745	7,690	
9	24	33	17·7	124	21·9	11·0	380	26·6	20,310	2,157	6,239	
*B-4	22	20	19·4	......	25·4	10·3	347	28·0	16,730	2,169	6,274	*Sound on testing. Numerous large knots.
Total...	214	223	150·8	1,115	218·0	104·7	3,617	278·4	193,070	23,336	68,745	
Average	23·8	27·9	16·8	139	21·8	10·5	362	27·8	19,307	2,334	6,875	
Max....	38	35	20·7	175	25·4	11·1	432	32·3	25,830	2,745	7,823	
Min....	16	20	11·1	115	17·7	9·7	325	26·4	16,050	1,701	5,318	

B GROUP.—SHOW WESTERN CEDAR BORER ATTACK

Pole No.	Rings per inch	Summerwood	Sapwood	Age	Moisture: Top section	Diameter: At load	Weight	Weight per cu. ft.	Maximum load	Top reaction adjusted to 7 inch top diam.	Modulus of rupture. Lbs. per square inch	Remarks
B-1	32	23	15·9	175	21·4	11·1	449	27·2	24,550	2,008	7,345	
2	23	21	20·6	170	22·5	9·8	310	27·6	17,300	2,673	7,487	
3	....	....	......	194	19·7	7·6	253	31·9	9,170	1,949	8,535	
5	19	41	12·0	135	24·5	12·3	478	28·5	22,710	2,474	4,973	Numerous large knots.
6	22	29	15·7	114	20·9	9·9	344	26·9	15,800	1,522	6,662	Sap partly decayed one side.
7	38	30	16·7	136	20·7	10·2	348	28·5	18,880	2,422	7,236	
8	29	25	18·2	167	23·3	10·9	442	30·0	24,030	2,144	7,575	
9	26	21	23·9	161	24·4	11·2	442	31·3	19,790	2,531	5,716	
10	20	22	38·5	136	24·6	9·4	292	27·7	10,800	1,718	5,303	
11	28	35	14·9	172	22·4	11·5	435	29·4	19,920	2,097	5,346	Large knots, not numerous.
*A-10	23	25	15·1	136	19·4	11·4	396	26·8	15,970	1,783	4,406	Western cedar borer work found on testing. Numerous large knots.
Total...	260	272	191·5	1,696	243·8	115·3	4,189	315·8	198,920	23,321	70,584	
Average	26·0	27·2	19·2	154	22·2	10·5	381	28·7	18.084	2,120	6,417	
Max....	38	41	38·5	194	24·6	12·3	478	31·9	24,550	2,673	8,535	
Min.....	19	21	12·0	114	19·4	7·6	253	26·8	9,170	1,522	4,406	

C GROUP.—SHOW WESTERN CEDAR BORER ATTACK

Pole No.	Rings per inch	Summerwood	Sapwood	Age	Moisture: Top section	Diameter: At load	Weight	Weight per cu. ft.	Maximum load	Top reaction adjusted to 7 inch top diam.	Modulus of rupture. Lbs. per square inch	Remarks
C-1	23	19	25·2	125	21·3	10·1	353	28·4	19,810	2,537	7,832	
2	38	31	18·3	218	23·4	10·7	385	28·0	13,400	1,757	4,479	Large knots-top end.
4	25	27	7·3	139	20·5	10·0	329	26·0	17,540	2,092	7,143	
5	23	22	14·4	161	19·2	10·7	413	27·2	18,780	2,107	6,295	Axe cut near load; decayed strip in sap 3 inches wide.
6	7	19	30·9	51	33·8	10·2	355	28·3	13,150	1,583	5,053	
7	13	32	23·4	66	23·3	11·6	455	29·6	22,520	2,379	5,881	Numerous large knots.
8	33	18	25·0	174	21·2	9·0	271	27·9	10,550	1,911	5,901	
9	21	21	16·6	155	24·8	9·1	273	26·2	10·500	1,558	5,697	
10	25	24	13·0	212	21·5	11·4	430	28·1	21,490	2,323	5,921	
11	20	25	20·8	129	24·2	10·5	355	30·1	14,140	2,459	4,975	Numerous large knots.
12	18	33	9·4	143	19·6	11·3	391	27·4	20,380	2,862	5,752	Numerous large knots.
13	22	18	......	106	32·5	11·1	445	30·4	22,190	2,216	6,620	
14	8	11	25·7	59	28·1	10·5	382	28·0	14,870	1,699	5,245	Large knots, not numerous.
Total...	276	300	230·0	1,738	313·4	136·2	4,837	365·6	219,320	27,483	76,794	
Average	21·2	23·1	19·2	134	24·1	10·5	372	28·1	16,871	2,114	5,907	
Max....	38	33	30·9	218	33·8	11·6	455	30·4	22,520	2,862	7,832	
Min.....	7	11	7·3	51	19·2	9·0	271	26·0	10,500	1,558	4,479	

PLATE X

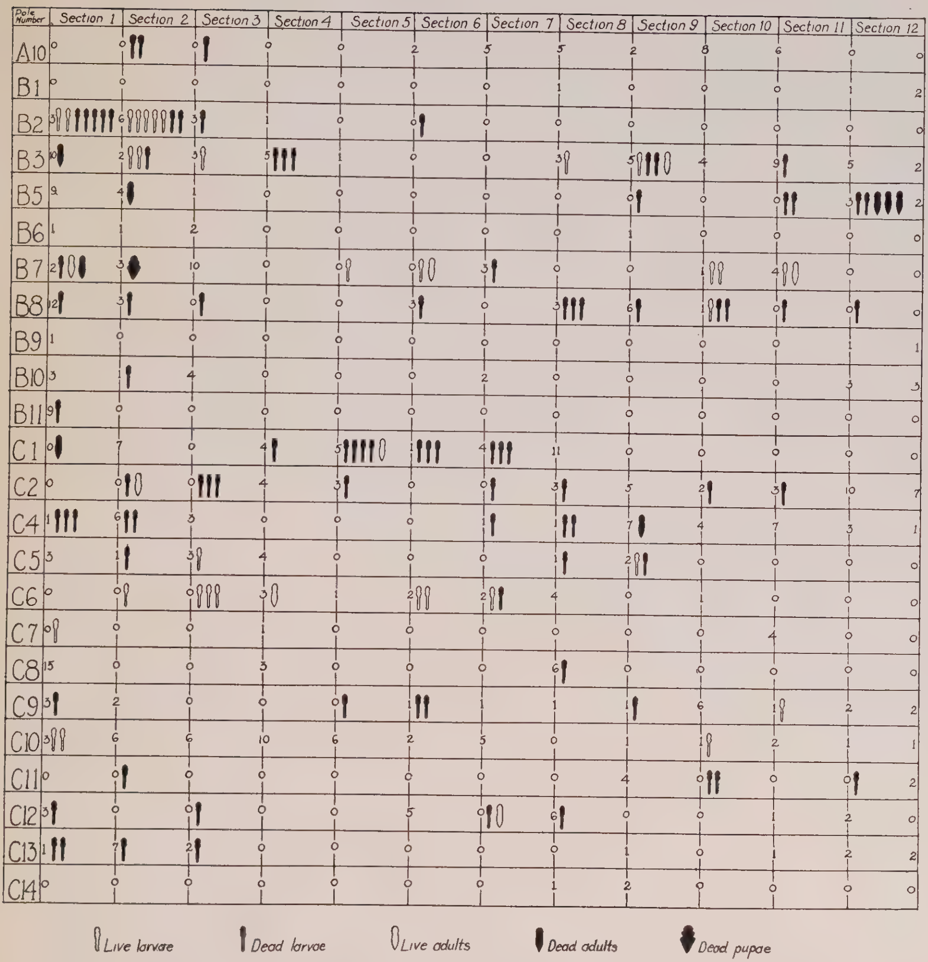
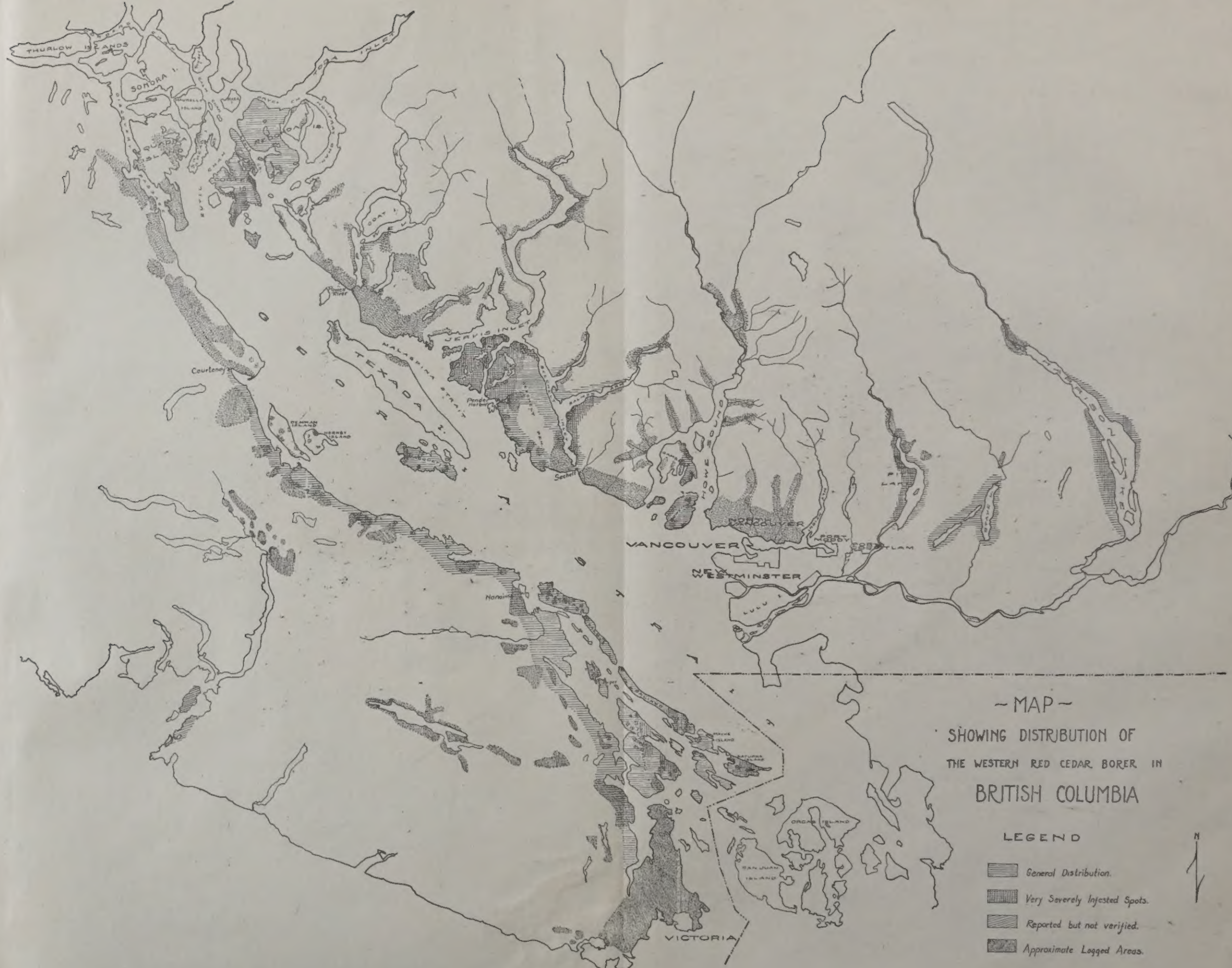


Chart showing the number and location of larvæ, adults, and pupae of the western cedar borer in infested cedar poles. Each division represents a two-foot section of a pole. Figures at the left hand margin represent the pole designations. The small figures between sections represent the number of galleries appearing on the cross sections of the pole at those points.


~MAP~
SHOWING DISTRIBUTION OF
THE WESTERN RED CEDAR BORER IN
BRITISH COLUMBIA
LEGEND
General Distribution.
Very Severely Infested Spots.
Reported but not verified.
Approximate Logged Areas.
N
THURLOW ISLANDS
SONORA I.
QUADRA ISLAND
TEXADA I.
MALASPINA STRAIT
JERVIS INLET
Courtenay
Pender Harbour
Sechelt
HOWE SOUND
NORTH VANCOUVER
VANCOUVER
PORT MOODY
COQUITLAM
NEW WESTMINSTER
LULU I.
Nanaimo
ORCAS ISLAND
SAN JUAN ISLAND
VICTORIA

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1928